



NDCEE

National Defense Center for Energy and Environment

Addressing Key Sustainability Issues for Military Installations in Hawaii

**E2S2 Conference
Denver, Colorado
May 6, 2009**

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DoD Executive Agent

Office of the
Assistant Secretary
of the Army
(Installations and
Environment)

The NDCEE is operated by:  *Concurrent Technologies Corporation*

Technology Transition – Supporting DoD Readiness, Sustainability, and the Warfighter

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE 06 MAY 2009		2. REPORT TYPE		3. DATES COVERED 00-00-2009 to 00-00-2009	
4. TITLE AND SUBTITLE Addressing Key Sustainability Issues for Military Installations in Hawaii				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) National Defense Center for Energy and Environment, Concurrent Technologies Corp, 100 CTC Drive, Johnstown, PA, 15904				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 4-7 May 2009 in Denver, CO.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 22	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Presentation Highlights

- Task Overview
- Identification of Key Sustainability Issues
- Technical and Economic Feasibility Study Results
- Siting Issues
- Next Steps

FY07 Regional Sustainability Solutions Technology Development, Demonstration, and Validation – Pacific Rim Region

Identify and conduct a technology demonstration/validation project in the Hawaiian Island region to support sustainability goals and objectives that span across all Services with a significant presence in the region

Team Members

- Naval Facilities Engineering Command, Hawaii (NAVFAC Hawaii)
- Pearl Harbor Naval Complex (Pearl City Peninsula Family Housing)
- Ohana Military Communities/Forest City Military Communities (FCMC) Hawaii
- National Renewable Energy Laboratory (NREL)
- National Defense Center for Energy and Environment (NDCEE)

Project Approach

- Identify key sustainability issues for Hawaii
- Identify technology opportunities that will address the issues
- Evaluate technology opportunities
- Demonstrate technology opportunity that has transition potential
- Technology transition with focus on Pacific Rim Region

Key Sustainability Issues

- Hawaii 2050 Sustainability Task Force
 - “Act 8” established by 2005 Hawaii state legislature
 - Hawaii 2050 Sustainability Plan
- Hawaii Clean Energy Initiative (HCEI)
- Mayor’s Energy and Sustainability Task Force

Outcome

- Reducing energy use and subsequently the high reliance that the Hawaiian Islands have on fossil fuel resources
 - Helps meet numerous local and military initiatives
 - Reduces the military's utility costs
 - Eases energy security concerns
 - Helps protect Hawaii's unique cultural and natural resources by reducing fossil-fuel generated pollution

Renewable Energy

Renewable Energy Categories

1. Biomass: derived from the organic material of agricultural crops, trees, plants, and some types of municipal solid waste
2. Geothermal: heat harvested from the earth and used as thermal energy or converted to electricity
3. Hydropower: energy produced by moving water to power machinery

Renewable Energy Categories (continued)

4. Ocean: can provide energy in the form of heat or mechanical motion created by tides and waves that can be converted to electricity
5. Solar: use of photovoltaic (PV) solar cell systems to convert the light of the sun directly into electricity
6. Wind: produced by wind turbines that convert kinetic energy from the natural motion or flow of air into mechanical energy, which is transformed into electricity

Advantages/Disadvantages

Technology	Advantages	Disadvantages
Biomass	Produced locally	Can produce pollution/GHG
	Low fuel cost	High capital costs
Geothermal	Low air/water pollution	Site specific
	Low land use required	High capital costs
Hydropower	Low air/water pollution	High capital/O&M costs
	Water storage	Ecological impacts
Ocean	Low air/water pollution	Ecological impact
	Local resource	High capital/O&M costs
Solar	Low air/water pollution	Intermittent resource
	Unlimited resource	High capital costs
Wind	Low air/water pollution	Intermittent resource
	Moderate costs	Visual impact

Solar and Wind: Best Renewable Options for O'ahu

- Their energy potential is excellent.
- They are technically feasible and practical.
 - Biomass feedstock is diminishing as agricultural industry declines.
 - Most prime geothermal areas reside within parks or natural reserves.
 - Hawaii's hydropower plants are mostly diversion facilities without dams, which can affect the reliability of energy generation.
 - Ocean energy is experimental.

Technical Feasibility

Stakeholders' Objectives	Solar	Wind
Technology Readiness	X	X
Electricity Production Costs	Evaluated during Cost Feasibility	Evaluated during Cost Feasibility
Sufficient Local Resources	X	X
Compatibility with Family Housing Locations	X	X
Sustainable Energy Portfolio	X	X
Reliability	X	X
Interconnectivity	X	X
Technology Transfer Potential	X	X

Economic Feasibility

- Economic Feasibility: f(system production, utility rates)
- Cost Avoidance
- *Electricity Production:*
 - PV system: 150,000 kilowatt-hours per year
 - Wind turbine: 50 kilowatt (75,000 – 95,000 kWh/year)
- *Electricity Utility Rates:*
 - Historical data
 - Government projections

Economic Analysis Data, Assumptions and Sources

Electricity Rate		Value	Unit	Source
	Fiscal Year 2008	0.19362	\$/kWh	Ohana Military Communities
	Ohana Historical Escalation Rate: 1996-2008	5.16	%	Calculated based on Ohana data
	Ohana Recent Escalation Rate: 2004-2008	12.04	%	Calculated based on Ohana data
Inflation Rate				
	Assumed Future Inflation Rate	3.00	%	Assumption
Discount Rate				
	Normal Discount Rate	4.90	%	OMB Circular, Appendix C, revised January 2008. http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html

PV Data, Assumptions and Sources

Photovoltaics	Value	Unit	Source
Capital Cost	828,587	\$	Ohana Military Communities
Solar Production	158,472	kWhr/yr	Ohana Military Communities
Operation and Maintenance (O&M) Costs			
System Size	110	kW	Assumption based on DOE estimated output for O'ahu
Annual O&M costs for 110 kW system in 2005	28.00	\$/kW/yr	Estimated using <i>Energy, Economic, and Environmental Benefits of the Solar America Initiative</i> . S. Grover, ECON Northwest, Subcontractor report, NREL/SR-640-41998. August 2007.
Annual O&M costs in 2008 dollars	29.73	\$/kW/yr	Calculated
Equipment Life	30	years	<i>Photovoltaics Value Analysis</i> . J.L. Contreras, L. Frantizis, S. Blazewicz, D. Pinault, and H. Sawyer Navigant Consulting Inc. Burlington, Massachusetts. NREL/SR-581-42303. February 2008.

Wind Data, Assumptions and Sources

Wind	Value	Unit	Source
Capital Cost	231,000	\$	Vendor Quote
Minimum Expected Production	75,000	kWhr/yr	Vendor Quote
Maximum Expected Production	95,000	kWhr/yr	Vendor Quote
Operating and Maintenance Costs	1,500	2008 \$	Vendor Quote
Equipment Life	30	years	American Wind Energy Association http://www.awea.org/smallwind/toolbox2/factsheet_econ_of_small_wind.html ; accessed August 2008.

Economic Evaluation Results

Scenario	Rate	Photovoltaics		Wind			
				Minimum Production		Maximum Production	
		Payback (yrs)	30-Year NPV	Payback (yrs)	30-Year NPV	Payback (yrs)	30-Year NPV
Scenario A	Ohana Historical Escalation Rate: 1996-2008	18	\$53,951	12	\$194,874	10**	\$315,700*
Scenario B	Ohana Recent Escalation Rate: 2004-2008	13	\$2,087,967*	9	\$1,157,512	8**	\$1,535,041
Scenario C	DOE Projected Fuel Price Indices	22	(\$207,300)	15	\$71,232	12**	\$159,086*

*Highest NPV for Rate; **Lowest Payback for Rate

Summary

- Value of renewable energy demonstration for the Pacific Rim Region
 - No fossil fuel resources, thereby reliance on imported fuel
 - High energy costs
 - Foreign oil dependence raises energy security concerns
 - Unique cultural/natural resources that could benefit from the reduction in fossil-fuel generated pollution
- Aggressive and conservative utility rates used
 - Economic feasibility highly dependent on unknown future electricity rates
 - Lower paybacks for the wind turbine indicate the fastest investment recovery and the lowest financial risk

Proposed Site



Wind Resource



Grid Tie-in



Next Steps

- Government Demonstration Approval
- Military Site Approval
- Development of Equipment Specifications
- Procurement and Installation
- Demonstration/Validation
- Technology Transition

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This work was funded through the Office of the Assistant Secretary of the Army (Installations and Environment) and conducted under contract W74V8H-04-D-0005 Tasks 440/501. The views, opinions, and/or findings contained in this paper are those of the author and should not be construed as an official Department of the Army position, policy, or decision unless so designated by other official documentation.